Optimizing Na and Rb incorporation along with bandgap grading for high efficiency ultra-thin CIGSe solar cells

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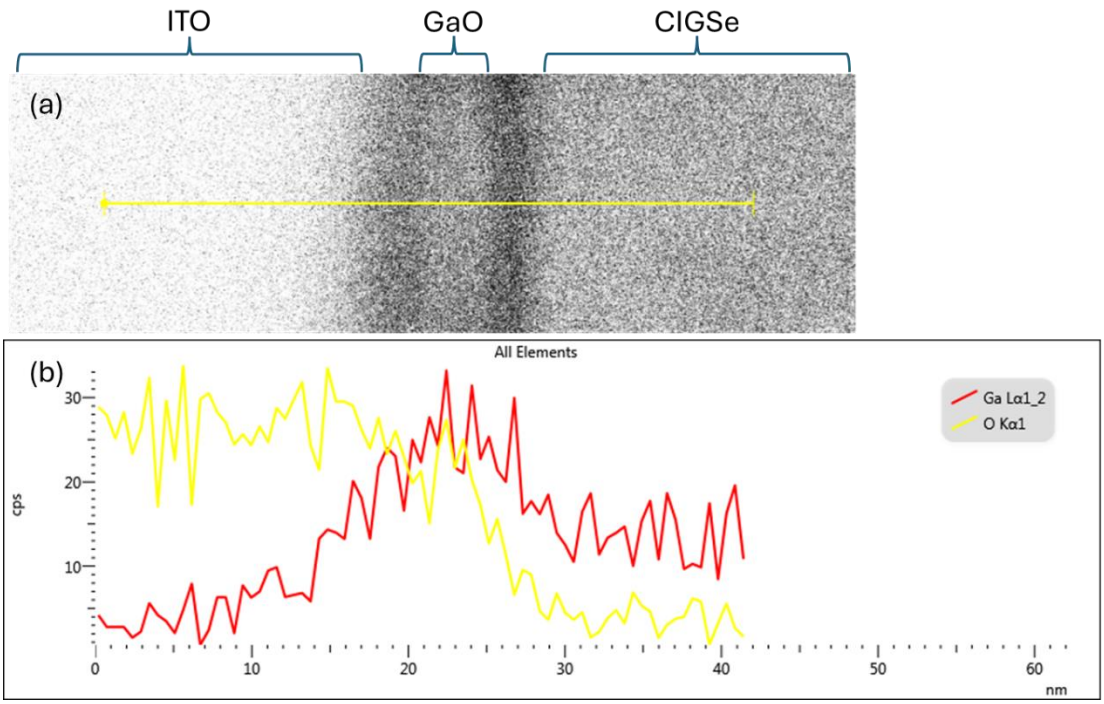

Figure S1 (a) TEM measurement of ITO/CIGSe interface for sample preNa2Rb6_GaIn with the yellow line being the marked area for (b) the EDX measurement of Ga and O.

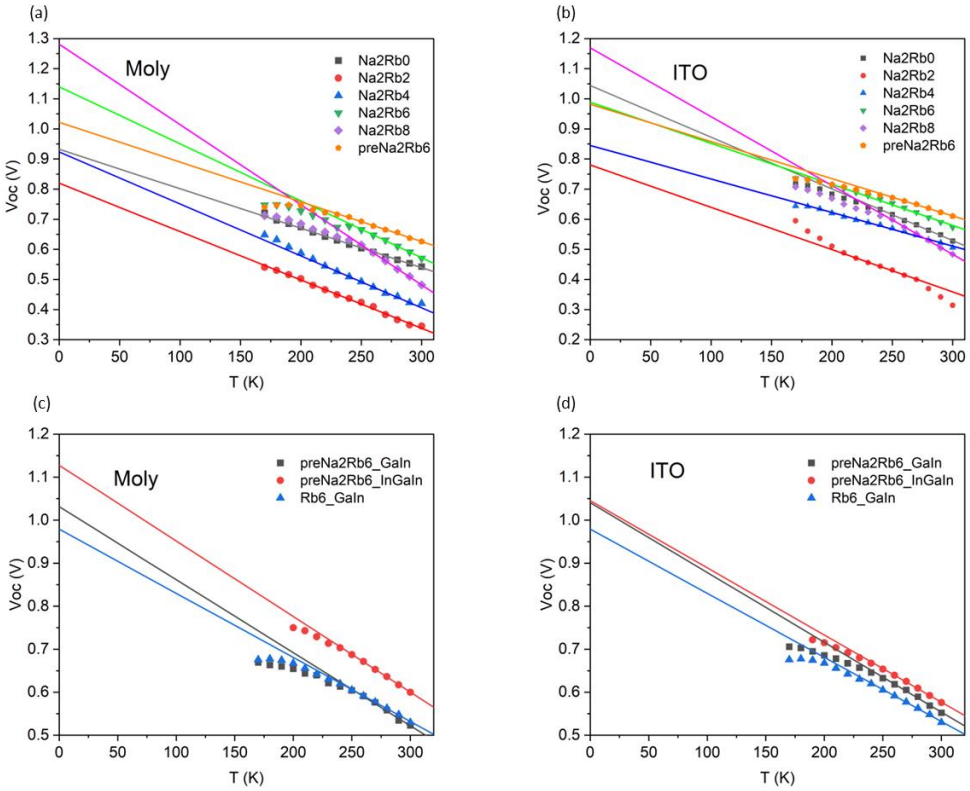

Figure S2. Extraction of activation energy E_a from linear fit on temperature-dependent V_{oc} measurement for different Na and Rb variations on (a), (c) Mo, and (b), (d) ITO substrates.

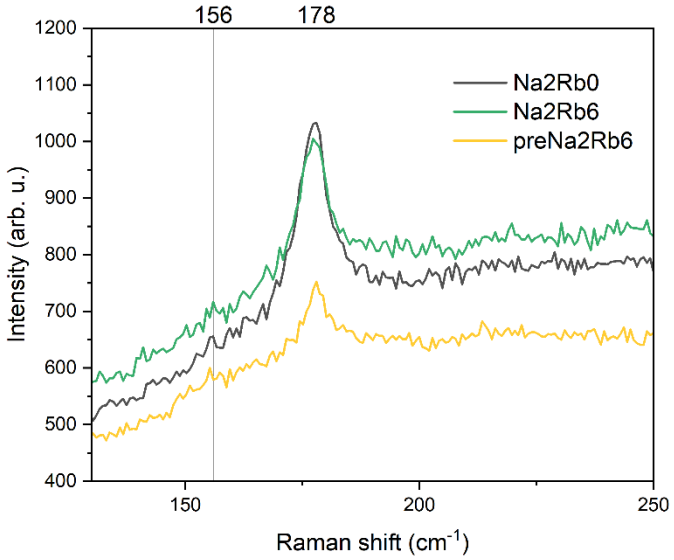

Figure S3 Raman measurement of Na and Rb treated samples. At 156cm^{-1} the OVC peak can be faintly seen. At 178 cm^{-1} a clear CIGSe peak is measured.

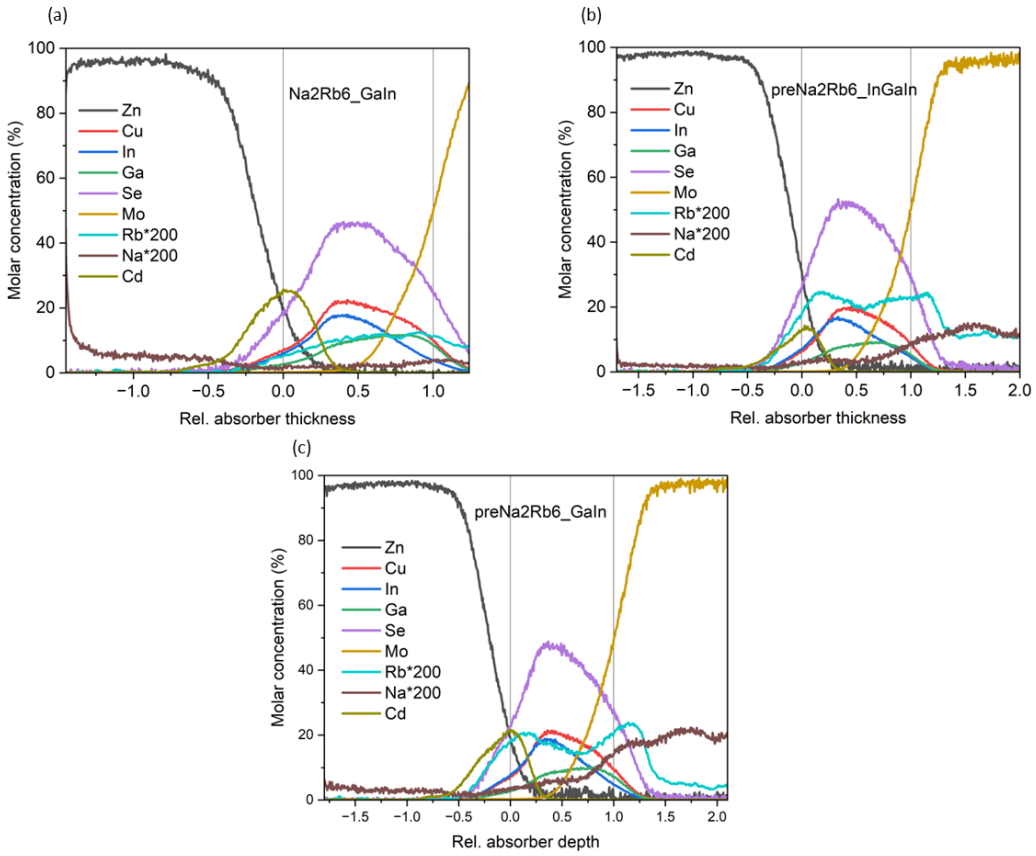

Figure S4 Complete GDOES-depth profile with rel. absorber depth for sample of ultra-thin CIGSe with (a) 2 mg preDT-Na, 6 mg Rb; (b) 2 mg preDT-Na, 6 mg Rb and adjusted Ga-gradient; (c) 0 mg Na, 6 mg Rb. The absorber region is estimated to lie between the vertical lines.